ARPA-E PROJECT SELECTIONS – FULL-SPECTRUM OPTIMIZED CONVERSION AND UTILIZATION OF SUNLIGHT (FOCUS)

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These projects have been selected for negotiation of awards; final award amounts may vary.

Lead Research	Amount	Lead	Project Title
Organization		Organization Location	Project Description
		(City, State)	
Arizona	\$3,900,000	Tempe,	High-Temperature Topping Cells from LED Materials
State		AZ	
University			Arizona State University will develop a solar cell that can
			operate efficiently at temperatures above 450°C, unlike
			today's solar cells, which lose efficiency rapidly above 100°C.
			The team will adapt semiconducting materials used in today's
			light-emitting diode (LED) industry to enable high-temperature
			operation. These solar cells will extract as much energy as
			possible from the highest-energy portion of the solar spectrum
	40.540.400	_	when used in the next generation of hybrid solar converters.
Arizona	\$2,640,122	Tempe,	Solar-Concentrating Photovoltaic Mirrors
State		AZ	Arizona Stata University will develop a surved mirror made of
University			Arizona State University will develop a curved mirror made of
			solar cells to collect both direct and diffuse sunlight for conversion to electricity and heat. While today's concentrating
			solar systems cannot use diffuse sunlight that has been
			scattered by the atmosphere, this system will simultaneously
			convert diffuse sunlight and some direct sunlight into
			electricity in solar cells while reflecting the unused portion of
			the direct sunlight for conversion to heat. This design can
			provide a low-cost way to utilize the diffuse portion of the
			solar spectrum.
Cogenra Solar,	\$1,996,127	Mountain	Double-Focus Hybrid Solar Energy System with Full Spectrum
Inc.		View,	Utilization
		CA	
			Cogenra Solar will develop a hybrid solar converter with a
			specialized light-filtering mirror that splits sunlight by
			wavelength, allowing a low-cost converter to integrate both
			efficient solar cells and a separate, high-temperature heat-
			storage component for on-demand conversion to electricity.
			The system would also capture waste heat from the solar cells,
			providing additional gains from the sun's energy. This hybrid
			converter could be used to provide inexpensive solar power
			from both centralized and distributed locations.

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Gas Technology	\$992,900	Des Plaines, IL	Double-Reflector Hybrid Solar Energy System
Institute			Gas Technology Institute will develop a hybrid solar converter
			that bounces sunlight off a mirror into a solar cell that
			converts most visible wavelengths of light to electricity while
			reflecting other wavelengths to heat a stream of flowing
			particles. This double-mirror design is optimized to capture as much of the energy in sunlight as possible. The team's ultra-
			high-efficiency converter could be used to provide solar
			electricity and simultaneously collect solar heat near a
			centralized point of use, such as in industrial parks or shopping
			centers.
General Electric	\$2,275,671	Niskayuna, NY	Electrothermal Energy Storage with a Supercritical CO2 Cycle
Global			GE will design and test components of a unique gas turbine
Research			that is driven by high-temperature, high-pressure carbon
			dioxide. The carbon dioxide expands to low pressure and
			extremely cold temperatures to generate electricity
			from stored electrical and heat energy. The dramatic change in temperature and pressure is necessitated by an innovative
			design that prevents thermal losses across the turbine. This
			grid-scale energy storage system could be coupled to a hybrid
			solar converter to deliver solar electricity on demand.
Massachusetts	\$3,420,000	Cambridge,	Full-Spectrum Stacked Solar-Thermal and PV Receiver
Institute of		MA	
Technology			The Massachusetts Institute of Technology will develop a
			hybrid solar converter that integrates a thermal absorber and a solar cell into a layered stack. The design allows focused
			sunlight to heat fluid piped through layers of optically
			transparent thermal insulation. The part of the spectrum most
			easily converted to electricity filters through to the solar cells.
			This unique stack design would enable low-cost solar energy
			conversion systems that can flexibly dispatch electricity when
Massashusatta	¢504.220	Complexides	most needed.
Massachusetts Institute of	\$594,329	Cambridge, MA	Low-Cost Hetero-Epitaxial Solar Cell for Hybrid Converter
Technology			The Massachusetts Institute of Technology will develop a high-
			efficiency solar cell grown on a low-cost silicon wafer
			incorporating a custom reflective filter. The color-selective filter is designed to split sunlight concentrated by a dish-
			shaped receiver into two components: one component is sent
			to the solar cells to be converted immediately into electricity
			and the other is sent to a thermal receiver to be stored as
			heat. The proposed system will enable more efficient use of
			solar energy to produce dispatchable renewable electricity on
			a utility scale.

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MicroLink	\$3,600,000	Niles,	Epitaxial Lift-Off III-V Solar Cell
Devices		IL	for High Temperature Operation
			MicroLink Devices will develop a high-efficiency solar cell that can operate at temperatures above 400°C, unlike today's solar cells which lose efficiency rapidly above 100°C. The team will customize the materials as well as the design of today's low-temperature concentrator solar cells to provide reliability over the 25-year lifetime needed in the field. In addition, MicroLink will use manufacturing techniques that allow for the reuse of expensive solar cell manufacturing templates to minimize costs. The high-temperature solar cells will be optimized to extract the most energy possible from sunlight when integrated with hybrid solar converters.
Northrop	\$2,362,197	Redondo	Thermo-Acoustic PV Hybrid Solar Energy System
Grumman Aerospace Systems		Beach, CA	Northrop Grumman Aerospace Systems will develop a dish- shaped hybrid solar converter that combines a high-efficiency solar cell with a thermo-acoustic engine that converts heat
			into electricity. The thermo-acoustic unit, which was originally designed for space missions, converts waste heat from the solar cell into sound waves that generate electricity using few moving parts. The engine and solar cell are surrounded by salts that store heat as needed by melting when the sun shines and releases the heat to make electricity by solidifying when the sun is not shinning. This combination could lead to
Otherlab	\$3,000,000	San Francisco,	inexpensive, on-demand electricity from solar energy. Hybrid Solar Converter with Solar Pond Receiver
		CA	Otherlab will develop an integrated system that splits the solar spectrum, converting the most suitable wavelengths of sunlight into electricity via high-efficiency solar cells and using the rest of the spectrum to directly heat a pool of molten salt. The system will collect sunlight using an array of small, pneumatically driven mirrors that track the sun's movement, allowing the molten salt pool to cost-effectively store solar heat for generation of dispatchable electricity. This technology could enable a low-cost solar system that would fit easily inside a football field, in contrast to today's solar fields that can cover several square miles.
Sharp Labs of America	\$4,182,929	Camas, WA	Sharp Labs of America will develop a hybrid solar converter that incorporates a partially transmitting mirror to reflect visible wavelengths of light to extremely high-efficiency solar cells while passing ultraviolet and most infrared light to heat a thermal fluid. The extremely high concentration of visible wavelengths of light would allow expensive solar cells to be

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			used in an inexpensive converter. The converter could enable utilities to provide dispatchable, on-demand, solar electricity at low cost.
The University of Tulsa	\$1,758,951	Tulsa, OK	Liquid Filter with Plasmonic Nanoparticles The University of Tulsa will develop a hybrid solar converter that captures non-visible wavelengths of light to heat a fluid containing light-absorbing nanoparticles that are far too small to be seen with the naked eye. The fluid would also transmit the part of the spectrum most easily converted to electricity to a solar cell and passes waste heat back to the fluid. This heat in the fluid can be stored to provide low-cost solar energy beyond the time when the sun is shining.